A

TREATISE

OF THE

Deſcription and Uſe

OF THE

GLOBES.

LONDON:

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A

TREATISE

OF THE

GLOBES.

LONDON:

A Catalogue of thoſe who were Encouragers of the Publiſhing, The New GLOBES Sixteen Inch Diameter.

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Of the GLOBES.

BY the Globes we here mean two Artificial Spherical Bodies, whoſe convex part is ſuppoſed to give a true and exact Repreſentation of the *Earth* and *Heavens*, as viſible by Obſervation: And therefore are call'd the *Terreſtrial* and *Cæleſtial Globes.*

The *Terreſtrial* or *Artificial Terraqueous Globe* has the whole Surface of the *Earth* and *Sea* delineated on its Convexity, in their natural Form, Order, and Situation. 'Tis made Spherical, to give a true Reſemblance in Figure between it and the *Natural Globe* of the Earth; which, in this Caſe, may be very well taken as ſuch.

The *Cæleſtial Globe* has the Images of the ſeveral Conſtellations and Stars drawn on its Surface, with their Magnitude expreſs'd, and their juſt and due Poſition, *&c.* Repreſented, according to their proper Situation in the Heavens.

For the better underſtanding theſe Globes, and diſtinguiſhing all their exterior Parts, with the various Operations to be perform'd by them, they are to be conceived, not barely as Spherical Bodies, but as ſuch ſurrounded with many imaginary Circumferences of great Circles, and their Parallels or ſmall Circles, as alſo having ſeveral remarkable *Points* and *Right-Lines*.

Of the Circles of the Sphere, and their Poles.

BY *Great Circles* are meant thoſe that divide the Globe into two equal Parts.

And by *Small Circles*, thoſe that divide it into two unequal Parts; and are generally denominated by their being *Parallel* to ſome *Great Circle*.

Every *Great Circle* has its *Poles* and *Axis*: A Point on the Surface of the Globe every where equally diſtant from the Circumference of a *Great Circle* is called the *Pole* of that Circle.

And a Right-Line paſſing thro' the Poles of any Circle is called an *Axis*, and is there-

therefore Perpendicular to the Plane of that Circle.

The *Axis of the World* or of the Natural Globe is an imaginary Right-Line paſſing thro' its Centre, and upon which 'tis ſuppoſed to turn round.

And in the *Artificial Globes*, it is not an imaginary Line, but that on which the Globe really turns.

The two extreme Points of the *Axis of the World* are call'd the *Poles of the World*: one of which is term'd the *North* or *Arctic*, and the other the *South* or *Antarctic Pole*.

The Circles common to both Globes are theſe Eight.

Four Great Circles, *viz.*	*Horizon.*
	Equator.
	Meridian.
	Ecliptic.
Four Leſſer Circles, *&c.*	Two *Tropics.*
	Two *Polar Circles.*

But ſeveral other Circles are drawn; and innumerable may be conceiv'd.

Of the Horizon.

THat Great Circle, which divides the Globe into two Parts, an *Upper* and *Lower*, in reſpect to us, is called the *Horizon*; and is of two Kinds, *viz. Rational*, and *Senſible*.

1. The *Rational*, *True*, or *Aſtronomic Horizon* divides the Globe into two equal Parts called the *Upper* and *Lower Hemiſpheres*.

Its Poles are called the *Zenith*, which is the Point directly over our Heads, and *Nadir*, which is the Point under our Feet, or Diametrically oppoſite to the *Zenith*.

Aſtronomic Calculation of the Riſing and Setting of the *Sun*, *Moon* and *Stars*, reſpects the *Rational Horizon*; And by this Circle the Days and Nights are determin'd, for while the Sun is above, it is Day, when under, Night.

The *True Horizon* is repreſented on the *Globe* by the upper Plane of the broad wooden Frame thereof; upon which are inſcribed ſeveral Circles: As,

The

The *Firſt* or innermoſt has the Number of Degrees of the twelve *Signs* of the *Zodiac*, Thirty Degrees to each *Sign*.

The *Second* has the Names, Marks and Figures of thoſe *Signs*.

The *Third* has the Kalendar, with the Days of the Month, *&c.* according to the *Old Stile* or *Julian Account*.

The *Fourth* has a Kalendar according to the *New Stile*, *Gregorian* or *Forreign Account*.

The *Fifth* or Outermoſt Circle has the Points of the *Nautical Compaſs*.

2. The *Senſible* or *Apparent Horizon* is the Extremity of the Earth, that Bounds our Sight, which for the moſt part is uneven; and at Sea is of a greater or leſs Extent, as the Eye is higher or lower: And ſuppoſing a Degree of the Circumference of the Earth to be 365000 Feet, *London* Meaſure, (as agreeing with the moſt accurate Obſervations yet made,) then will the Circumference be 26280 Miles, each of 5000 Feet, and conſequently the Diameter of the Earth will be about 8365,184 Miles.

And therefore the Eye, at the hight of 5 Feet above the Surface of the Water, will see but 2,262 Miles off, at 20 Feet high, 5,784 Miles, at 50 Feet, 9,146 Miles, and at 100 Feet high, 12,932 Miles every way: Or generally, putting d for the Diameter of the Earth, and h for the hight of the Eye above the Surface of the Water, the Semi-diameter of the *Sensible Horizon* will be equal to $\sqrt{d+h \times h}$.

Tho' the Rising and Setting of the Stars respect the Rational *Horizon*, yet by Reason of their vast distance, it holds true of the *Sensible*, which is more than 4000 Miles above it.

Of Circles Parallel to the Horizon.

CIrcles Parallel to the *Horizon*, passing thro' each Point of a Great Circle drawn thro' the *Zenith* and *Nadir*, are called *Almicantars* or *Parallels* of *Altitude*.

That at 18 Degr. below the *Horizon* is called the *Crepusculum Circle*; for when the *Sun* is about 18 Degr. beneath the *Horizon*, the Morning *Twilight* begins, and the Evening *Twilight* ends.

Of

Of the Ecliptic *and* Zodiac.

THat Great Circle, which the *Sun* is ſuppoſed to deſcribe in its *Proper Motion*, is called the *Ecliptic* or the *Sun's Orbit*.

For the *Sun* is here ſuppoſed to have Two Motions.

1. A *Diurnal Motion* from *Eaſt* to *Weſt* about the Poles of the World, in Circles Parallel to the Equinoctial, in 24 Hours.

2. A *Proper Motion* from *Weſt* Obliquely to *Eaſt* in the *Ecliptic*, in one *Natural* or *Tropical Year* : *i. e.* in 365 Days, 5 Hours, 48 Minutes, 57 Seconds.

The better to diſtinguiſh theſe Motions, conceive a Worm creeping ſlowly in the *Ecliptic*, while the Globe is turn'd once round the other way; hereby the *Sun* may be ſaid to deſcribe each Day a Parallel to the Equinoctial, (tho' properly 'tis a *Spiral Line*) and yet is never out of the *Ecliptic*.

The *Planets* alſo, beſides a *Diurnal Motion* from *Eaſt* to *Weſt*, have a *Proper Motion* in their Orbits from *Weſt* to *Eaſt*.

		Y.	D.	H.
Saturn	Finiſhes its Courſe in	30,	000,	00
Jupiter		12,	000,	00
Mars		01,	315,	00
Venus		00,	224,	18
Mercury		00,	88,	00
Moon		00,	27,	08

The Orbit of each *Planet* cuts the *Ecliptic* in two oppoſite Points called *Nodes.*

The Orbit of *Venus* is ſo oblique to the *Ecliptic*, that ſhe may be about 8 or 9 Degrees diſtant from it.

Hence the Zone including the ways of the Planets, or the *Zodiac*, is reckon'd to be about 8 Degrees broad on each ſide of the *Ecliptic.*

The *Ecliptic* is divided into twelve equal Parts called *Signs*, of 30 Degrees each, whoſe Names and Characters are theſe, *viz.*

Aries	♈	*Libra*	♎
Taurus	♉	*Scorpio*	♏
Gemini	♊	*Sagittarius*	♐
Cancer	♋	*Capricornus*	♑
Leo	♌	*Aquarius*	♒
Virgo	♍	*Piſces*	♓

The

The Equinoctial cuts the *Ecliptic* in the oppoſite Points of *Aries* and *Libra*, (their Planes making an Angle of 23 Deg. 29 Min.) and theſe Points are called the *Equinoctial Points*.

When the *Sun* is at the Equinoxes, the Days alter much; for here the *Ecliptic* is moſt Oblique to the Equator.

The Tropics touch the *Ecliptic* in the oppoſite Points of *Cancer* and *Capricorn*, which therefore are called the *Soliſticial Points*: When the *Sun* is at the Solſtices, the Days alter but little; for there the *Ecliptic* is almoſt Parallel to the Equator.

The Fix'd *Stars* have likewiſe a *Diurnal Motion* from *Eaſt* to *Weſt*, and a *Proper Motion* from *Weſt* to *Eaſt*, in Circles Parallel to the *Ecliptic*, and therefore Equidiſtant from its Poles, about 50 Seconds in a Year, and therefore, in about 25920 Years, will make an intire Revolution; as is eaſily computed by comparing Antient Obſervations, with thoſe made of late: and this Period is called the *Platonic Year*.

From this Motion 'tis, that the Conſtellations of the *Zodiac* have left the Signs to which they gave Name: The Aſteriſm *Aries* being now almoſt mov'd into the Sign *Taurus*.

And from hence alſo, it is, that the *Pole Star* has not always bin ſo, nor will be: but its leaſt diſtance from the *Pole*, *Anno* 2101, will be about 28 Min. and its greateſt, *Anno* 15061, will be about 47 Degr. and 26 Min.

Of the Equator *or* Equinoctial.

THat Great Circle on the Globe, whoſe Poles are thoſe of the World, is called the *Equator* or *Equinoctial.*

It divides the Globe into two equal parts called the *Northern* and *Southern* Hemiſpheres.

The Circumference of this Great Circle paſſes thro' the *Eaſt* and *Weſt* Points of the Horizon.

Therefore the Stars, which are under the Equinoctial, always Riſe due *Eaſt* and Set due *Weſt.*

And the Sun, when 'tis ſaid to come to this Circle, makes the Days and Nights every where equal; For then only 'tis ſaid to Riſe and Set due *Eaſt* and *Weſt.*

The

The *Equinoctial*, *Equator*, or what Seamen call the *Line*, is ſuppoſed to be divided into 360 equal Parts called *Degrees*: And a Natural Day is meaſured by a Revolution of the Equinoctial, that is, 360 Degrees revolve in 24 Hours, therefore,

$\frac{360}{24}$ = 15 Degr. } of the Equator in { 1 Hour } of Time.
1 Degr. } { 4 Min }
15 Min. } { 1 Min }
1 Min. { 4 Sec.

Which, in *Aſtronomy*, is to be Noted, for the reducing of Degrees, Min. *&c.* into Time, and the contrary.

Of Circles Parallel to the Equator.

CIrcles Parallel to the Equator, paſſing thro' each Point of a Great Circle drawn thro' the Poles of the World, are, with reſpect to the Earth, called *Parallels of Latitude*: but with reſpect to the Stars and Planets, they are called *Parallels of Declination.*

And the Extreme Parallels of the Sun's Declination, or thoſe at 23 *Degr.* and 29 *Min.* diſtant from the Equator, which the Sun

Sun is ſuppoſed to deſcribe on the 10th of *June*, and on the 12th of *December*, are called the *Tropics* of *Cancer* and *Capricorn*.

Thoſe Parallels to the Equator, at 23 *Degr.* and 29 *Min.* diſtant from its *Poles*, Northern or Southern, are called *Polar Circles*, viz. *Arctic* and *Antarctic Circle*.

Of the Meridian.

A Great Circle paſſing thro' the Poles of the World, the Zenith and Nadir is called a *Meridian*: which, therefore, cuts the Equinoctial at right Angles, and divides the Globe into two equal Parts called the *Eaſtern* and *Weſtern Hemiſpheres*; and its Poles are the *Eaſt* and *Weſt* Points of the Horizon. Meridians are alſo called *Circles of Longitude* on the Terreſtrial Globe, and ſometimes *Circles* of *Declination*.

But on the Cœleſtial Globe, thoſe are *Circles of Longitude*, which paſs thro' the Poles of the *Ecliptic*, and thro' each Degree thereof.

Thoſe two Meridians, which paſs, the one thro' the beginning of *Aries* and *Libra*, the other

ther thro' the beginning of *Cancer* and *Capricorn*, are called the *Equinoctial* and *Solſticial Colures*; which therefore cut one another at Right Angles, and divide the *Ecliptic* into four equal Parts.

Thoſe *Meridians*, which are drawn thro' every 15th Degree of the Equinoctial, are called *Hour Circles*.

The *Firſt Meridian* is that from whence the Longitudes of Places are reckon'd; *Ptolemy* placed the *Firſt Meridian* one Degree beyond the *Fortunate* or *Canary* Iſlands; after the Diſcovery of *America*, it was fix'd in St. *Nicholas*, one of the *Cape Virde* Iſlands; *Hondius* plac'd it at St. *Jago*; *Mercator* at *Corvo*, one of the Weſtern Iſles; the *Dutch* reckon from the *Meridian* of the *Teneriff*; the *French* from a *Meridian* paſſing over the middle of *Fero*, the Weſternmoſt of the *Canary Iſles*.

But it is abundantly ſufficient for all purpoſes, if the diſtance or difference of Meridians, *i. e.* the Arc of the Equator intercepted between them, be known, which will or ſhou'd be found the ſame in all Authors: And therefore every Aſtronomer, Calculator of Tables, and Geographer makes his own *Meridian* the firſt, and

for

for that Reaſon, we reckon the *Longitude* from the *Meridian* of *London*: But at Sea, 'tis uſual to reckon it from the *Meridian* of the Place departed from, or laſt ſeen, making that the *Firſt Meridian*, till another known Land is ſeen, and no longer.

Of Vertical or Azimuthal Circles.

GReat Circles paſſing thro' the Vertex or Zenith, Nadir, and the ſeveral Points of the Horizon, are called *Vertical* or *Azimuthal Circles.*

That which paſſes thro' the *Eaſt* and *Weſt* Points of the Horizon is called the *Prime Vertical.*

And the *Vertical Circle*, which paſſes thro' the Poles of the Ecliptic, and conſequently cuts the Ecliptic at right Angles in the *Nonageſim Degree*, or in the 90th Degree from the Horizon, is called the *Nonageſim Circle* or the Circle of the *Nonageſim Degree.*

Expli-

Explication of ſome Words relating to the Sphere.

1. BY the *Altitude* of any Point in the Heavens, is meant an Arc of a vertical Circle intercepted between that Point and the Horizon.

2. The *Declination* of any Point in the Heavens is an Arc of the Meridian intercepted between that Point and the Equinoctial.

3. The *Right Aſcenſion* of any Point is an Arc of the Equinoctial intercepted between the beginning of *Aries* and the Meridian paſſing thro' that Point, Or is the Angle made by the Equinoctial Colure and the Meridian of that Point.

4. The *Oblique Aſcenſion*, or *Deſcenſion* is an Arc of the Equinoctial intercepted between the beginning of *Aries* and that part of the Equinoctial which Riſes, or Sets with that Point, in an Oblique Sphere.

5. The *Aſcenſional Difference* is the Difference between the Right and Oblique Aſcenſion or Deſcenſion; or that Arc of the

the Equator intercepted between the Points of Right and Oblique Aſcenſion: or 'tis the Difference between a Semidiurnal Arc and 90 Degrees or 6 Hours.

Therefore, if the *Sun* have North, or South Declination, its *Aſcenſional Difference* is the Time of its Riſing before, or after the Hour of 6.

6. The *Azimuth* is an Arc of the Horizon intercepted between a Vertical Circle paſſing thro' any Point above the Horizon, and the Meridian; Or is the Angle at the Zenith, made by a Vertical Circle paſſing thro' the given Point, and the Meridian.

7. The *Amplitude* is an Arc of the Horizon intercepted between any Point, at its Riſing or Setting, and the Eaſt or Weſt Points of the Horizon: Or is the Angle made by a vertical Circle paſſing thro' any Point at its Riſing or Setting, and the Prime Vertical.

8. The *Longitude* of any Point in the Heavens is an Arc of the Ecliptic intercepted between a Circle of Longitude paſſing thro' that Point and the Equinoctial Point *Aries*.

By the *Place of a Star* is meant that Point of the Ecliptic over which runs a Circle of Longitude paſſing thro' that Star.

The

The *Longitude of the Sun* is an Arc of the Ecliptic intercepted between the *Sun* and the Equinoctial Point *Aries*.

By the *Place of the Sun* is meant that Sign, Degree, or Minute, *&c.* of the Ecliptic, in which the Sun is at any time.

9. The *Latitude* of any Point in the Heavens is an Arc of a Circle of Longitude passing thro' that Point, intercepted between it and the Ecliptic.

Of the Poetical Rising and Setting of the Stars.

THat Star which Rises, or Sets, when the *Sun* Rises, is said to *Rise*, or *Set Cosmically*.

And that Star which Rises or Sets when the *Sun* Sets, is said to Rise or Set *Acronically*

A Star is said to *Rise Heliacally*, when first it emerges out of the Sun's Beams, which hid it before.

And a Star is said to *Set Heliacally*, when 'tis first immers'd or hid in the Sun's Beams.

The

The Fix'd Stars, as alſo *Saturn*, *Jupiter* and *Mars* Riſe *Heliacally* in the Morning; but the *Moon* Riſes *Heliacally* in the Evening; for the *Sun* is ſwifter than the Superior Planets, but ſlower than the *Moon*.

The Depreſſion of the *Sun* under the Horizon, when a Star Riſes or Sets *Heliacally* is called the *Arc of Viſion*: And according to the Antients, this Arc, for Stars of the 1ſt, 2d, 3d, 4th, 5th, 6th, Magnitude, is 12°, 13°, 14°, 15°, 16°, 17°, and at 18°, Depreſſion, all the Stars appear: But 'tis known, that a Star may be ſeen, when the Sun has a much leſs Depreſſion than aſſign'd by the Antients; *Jupiter* and *Venus*, when they are brighteſt, may be ſeen by Day.

Of the various Poſitions of the Globe, or Sphere.

1. *Of the* Right Poſition.

THat Poſition of the Sphere, where the Equator is Perpendicular to the Horizon, is called the *Right Poſition*.

1. Here both Poles are in the Horizon.

2. All

2. All the Stars do Riſe and Set.

3. All the Nocturnal Arcs are equal to their Diurnal; and therefore, a perpetual equallity of Days and Nights.

4. The Twi-light is here ſhorteſt; becauſe the Sun aſcends Right to the Horizon.

2. *Of the* Oblique Poſition.

THat Poſition of the Sphere, where the Equator is Oblique to the Horizon, is called the *Oblique Poſition.*

1. Here, when the Sun is in the Equator, it makes the Days and Nights every where equal.

2. The greater the Elevation of the Pole is, the longer the Summer Days are, and the ſhorter the Winter Days: So that under the Polar Circles, at the Solſtices, 'tis all Day, or all Night.

3. The Twi light is ſo much the longer, as the Pole is higher. So that in the *North* of *Scotland*, about the Summer Solſtice, the Twi-light is ſufficient to read by at Midnight.

3. *Of*

3. *Of the* Parallel Poſition.

THat Poſition of the Sphere, where the Equator is Parallel to the Horizon, is called the *Parallel Poſition.*

1. Here the Poles of the Equator are in the Zenith and Nadir.

2. The Stars and Planets, in their Diurnal Motion, deſcribe Circumferences Parallel to the Horizon.

3. The Sun is half a Year above, and half a Year under the Horizon; for the Horizon biſects the Ecliptic.

4. Here the ſame Hemiſphere of *Fix'd Stars* is always above the Horizon; and each *Planet* during half its Period, *viz. Saturn* 15 Years, *Jupiter* 6, *Mars* 1, &c.

But the Polar Inhabitants (if any) are not in Darkneſs all the time of the Sun's abſence: For, the *Moon* while brighteſt, *viz.* from the firſt Quarter to the laſt, does not Set.

And the Twi-light laſts while the *Sun* has leſs than 18 Degrees Declination; ſo that thoſe under the North Pole (for Inſtance,) are

are without Twi-light only from the beginning of *November* till the middle of *January*.

Alſo becauſe of the *Refraction* in ſuch thick Air, the *Sun* appears ſooner, and goes off later by ſeveral Days than elſe it wou'd: As has bin found by Experience.

The Diviſion of the Earth into Zones.

THe two Tropics and the two Polar Circles divide the Surface of the Earth into Five Bands called the *Terreſtrial Zones*, which have their Names from the Quality of the Temperature which their Situation is Subject to, *viz.*

Two *Temperate Zones*, comprehended betwixt the Tropics and the Polar Circles.

Two *Frigid Zones*, comprehended within the Polar Circles.

One *Torrid Zone*, comprehended between the two Tropics.

The

The Diviſion of the Earth by the Diverſity of Shadows.

THe Inhabitants of the Frigid Zone are called *Periſciens*; becauſe in the longeſt Day, their Shadow goes round about them.

The Inhabitants of the Torrid Zone are called *Amphiſciens*; becauſe their Noon Shadow is caſt different ways, according as the Sun is to the Northward or Southward of their Zenith.

But when the Sun is in their Zenith they are called *Aſciens*.

The Inhabitants of the Temperate Zone are called *Heteroſciens*, becauſe their Noon Shadow is caſt but one way.

But thoſe that live under the Tropics are called *Aſciens Heteroſciens*.

The Diviſion of the Earth by Situation.

THoſe who live under the ſame Points of equal and contrary Parallels are called *Antœciens*: Their Seaſons of the Year

Year are contrary: The Days of the one are equal to the Nights of the other: The Hour of the Day and Night is the ſame: And only when the Sun is in the Equinoctial it riſes with the one when it Riſes with the other.

Thoſe who live under oppoſite Points of the ſame Parallel are called *Periœciens*: They have the ſame Seaſons of the Year; the ſame Length of Days and Nights; the one's Noon is the other's Midnight: And only when the Sun is in the Equinoctial it Riſes with the one when it Sets with the other.

Thoſe who live under oppoſite Points of equal and contrary Parallels are called *Antipodes*: Theſe have contrary times of the Year and Day; the one's Longeſt Day or Night is the other's Shorteſt: The Sun always Riſes with the one when it Sets with the other.

The Diviſion of the Earth by Longitude *and* Latitude.

THat the different Places on the Earth might be the better diſtinguiſh'd, their Situation may be compar'd, either,

1. By

1. By how much any Place is to the Eaſtward or Weſtward of ſome given Meridian, reckoning on the Equator; and the diſtance is called the *Longitude* of that Place.

2. By how much any Place is to the Northward or Southward of the Equator, reckoning on the Meridian, and the diſtance is called the *Latitude* of that Place: Therefore,

The *Longitude* of any Point on the Earth is an Arc of the Equator, intercepted between a Meridian paſſing thro' that Point and the Firſt Meridian.

The *Latitude* of any Point on the Earth is an Arc of a Meridian paſſing thro' that Point, and intercepted between it and the Equator.

The Diviſion of the Earth by Climates.

A Tract of the Surface of the Earth included between two Parallels to the Equator, ſuch, that the longeſt Day of the leſſer Parallel exceeds that of the greater by half an Hour, is called a *Climate.*

Theſe

Theſe Climates are narrower the farther they are from the Equator; therefore, ſuppoſing the Equator the beginning of the firſt Climate, the Polar Circle will be the end of the 24th Climate; for afterwards the longeſt Day encreaſes not by Half Hours, but by Days and Months. The following Table of the Climates ſhews the length of the longeſt Days, and the Latitude at the end of each Climate, together with the breadth thereof. So that having the Climate given, the Latitude is found; or having the Latitude given the Climate and Longeſt Day are found.

A Table ſhewing the Latitude of thoſe Places where the Longeſt Day makes entire Months.

Length of Days	Latitudes.	
Months.	D.	M.
1	67	21
2	69	48
3	73	37
4	78	30
5	84	05
6	90	00

The Table of the Climates.

Clim	Length of Days. Hours.	Latitude. D. M.	Breadth. D. M.
1	12½	8 . 34	8 . 34
2	12	16 . 43	7 . 50
3	13½	23 . 11	7 . 03
4	14	30 . 47	6 . 09
5	14½	36 . 30	5 . 17
6	15	41 . 22	4 . 20
7	15½	44 . 29	3 . 48
8	16	49 . 01	3 . 12
9	16½	51 . 58	2 . 44
10	17	54 . 29	2 . 17
11	17½	56 . 37	2 . 00
12	18	58 . 26	1 . 40
13	18½	59 . 59	1 . 26
14	19	61 . 18	1 . 13
15	19½	62 . 25	1 . 01
16	20	63 . 22	0 . 52
17	20½	64 . 06	0 . 44
18	21	64 . 46	0 . 36
19	21½	65 . 21	0 . 29
20	22	65 . 47	0 . 22
21	22½	66 . 06	0 . 17
22	23	66 . 20	0 . 11
23	23½	66 . 28	0 . 04
24	24	66 . 30	0 . 01

The Diviſion of the Earth into Parts Right and Left.

FOr the underſtanding of Authors, wherein any mention is made of the Right and Left Part of the World; ſince ſome call the Eaſt the Right-Hand Part, ſome the Weſt, and ſome the North, others the South, 'tis to be noted, that

The *Geographers*, who look to the North, reckon the Eaſt the Right, and the Weſt the Left-Hand Part of the World.

The Northern *Aſtronomers* regard the South, and therefore reckon the Weſt the Right, and the Eaſt the Left-Hand Part of the World.

The *Divines*, who regard the Eaſt, have the South to the Right, and the North to the Left-Hand.

The *Poets*, who regard the Weſt, reckon the North the Right, and the South the Left-Hand Part of the World.

Which is all contain'd in this Verſe;

Ad Boream Terræ, ſtat Cœli Menſor ad Auſtrum.
Præco Dei exortum Videt, Occaſumq; Poeta.

Of the Natural and Political Diviſion of the Earth.

BY the *Natural Diviſion of the Earth* we mean thoſe made by Nature in the ſeveral Parts thereof, as *Seas*, *Lakes*, *Rivers*, *Iſlands*, *Continents*, *Mountains*, and all other remarkable Parts of which the Surface of the Earth is Naturally Compounded.

By the *Political Diviſion of the Earth* we mean thoſe Eſtabliſh'd by Men, as *Empires*, *Kingdoms*, *Provinces*, *Countries*, *Monarchies*, *Republics*, *Principalities*, *Dukedoms*, *Dioceſſes*, *Pariſhes*, *Cities*, *Towns*, *Villages*, &c.

Of the Conſtellations.

AS Geographers, for the readier diſtinction of Places, divide the Surface of the Earth into Kingdoms and Provinces; ſo likewiſe the Aſtronomers, that they might the better know the fix'd Stars, and give them Names, have divided them into *Conſtellations* or *Aſteriſms*; as in the following Tables.

The

The Northern Conſtellations.

NAMES.	MAGNITUDE							
	N	1	2	3	4	5	6	7
Urſa Minor	12	0	2	1	3	3	3	0
Urſa Major	73	0	7	4	16	22	24	0
Draco	40	0	1	11	13	10	5	0
Cepheus	51	0	0	3	9	13	25	1
Canes Venatici	23	0	1	0	3	8	10	1
Bootes et *Mons Mœnalus*	52	1	0	7	14	17	12	1
Coma Berenices	21	0	0	0	4	11	3	3
Corona Borealis	8	0	1	0	4	3	0	0
Hercules	45	0	0	8	15	15	6	1
Cerberus	4	0	0	0	1	3	0	0
Lyra	17	1	0	1	1	8	6	0
Cygnus	47	0	1	6	17	18	5	0
Vulpecula cum *Anſere*	27	0	1	0	1	10	15	0
Lacerta ſive *Stellio*	10	0	0	0	0	6	4	0
Caſſiopeia	37	0	0	5	5	7	18	2
Camelopardalus	32	0	0	0	4	15	13	0
Serpens	22	0	1	7	8	3	3	0
Serpentarius	44	0	1	7	18	14	6	0
Scutum Sobieſcianum	7	0	0	0	2	4	1	0
Aquila	23	1	0	2	5	4	11	0
Antinous	19	0	0	3	6	6	4	0
Delphinus	14	0	0	4	1	2	7	0
Equuleus	6	0	0	1	3	1	1	0
Sagitta	5	0	0	0	4	0	1	0
Andromeda	46	0	3	2	10	10	20	1
Perſeus	46	0	2	4	11	13	16	0
Pagaſus	37	0	3	3	7	7	15	2
Auriga	40	1	1	2	6	17	13	0
Lynx	19	0	0	1	0	8	10	0
Leo Minor	18	0	0	3	3	2	10	0
Triangulum Major	9	0	0	0	3	2	4	0
Triangulum Minor	3	0	0	0	0	0	3	0

The Southern Conſtellations.

NAMES.	MAGNITUDE.							
	N.	1	2	3	4	5	6	7
Cetus	46	0	3	9	10	12	10	2
Eridanus	27	0	0	7	15	5	0	0
Phœnix	13	0	1	5	5	2	0	0
Toucan ſive *Anſer Amer.*	9	0	0	4	2	3	0	0
Orion	62	2	4	4	9	24	18	1
Monoceros	19	0	0	0	10	7	2	0
Canis Minor	13	1	0	1	0	4	7	0
Hydra	31	1	0	1	12	8	9	0
Uraniæ Sextans	12	0	0	0	1	5	5	1
Crater	10	0	0	0	7	1	2	0
Corvus	8	0	0	3	2	2	1	0
Centaurus et *Crux*	35	1	6	7	9	10	1	1
Lupus	23	0	0	2	3	14	4	0
Ara	9	0	0	1	6	1	1	0
Triangulum Auſt.	5	0	1	2	0	2	0	0
Pavo	14	0	1	3	5	4	1	0
Corona Auſtralis	12	0	0	0	1	3	8	0
Grus	13	0	2	1	2	8	0	0
Piſcis Notius	17	0	0	4	10	3	0	0
Lepus	16	0	0	2	9	4	1	0
Columba	10	0	2	0	2	6	1	0
Robur Carolinum	12	0	1	2	7	2	0	0
Argo Navis	40	1	6	7	12	13	1	0
Canis Major	21	1	5	1	4	10	0	0
Muſca ſive *Apis*	4	0	0	0	2	2	0	0
Apus ſive *Avis Indica*	11	0	0	0	4	3	4	0
Indus	12	0	0	1	1	2	8	0
Chamæleon	10	0	0	0	0	9	1	0
Piſcis Volans	8	0	0	0	0	7	1	0
Xiphias ſive *Dorado*	6	0	0	1	2	1	2	0

The Zodiac Conſtellations.

NAMES.	MAGNITUDE.							
	N	1	2	3	4	5	6	7
Aries	27	0	1	2	4	6	13	1
Taurus	52	1	1	4	9	19	17	0
Gemini	38	0	3	3	9	7	16	0
Cancer	25	0	0	2	3	7	16	1
Leo Major	46	1	2	5	14	10	14	0
Virgo	50	1	0	6	6	20	15	2
Libra	20	0	2	1	4	5	6	2
Scorpius	20	1	1	3	7	4	3	1
Sagittarius	22	0	0	2	8	5	3	0
Capricornus	27	0	0	4	2	8	13	0
Aquarius	48	1	0	4	7	21	13	1
Piſces	39	0	0	1	6	20	12	0

The Syſtem of the World.

Ariſtotle, *Ptolemy*, and others of the Antients, ſuppoſed that the *Moon*, *Mercury*, *Venus*, the *Sun*, *Mars*, *Jupiter*, *Saturn*, and *Fix'd Stars*, in order, are carried round the *Earth* in Concentric Orbs, once in 24 Hours

Argol, *Vitruvius*, and others, ſuppoſed the *Moon*, *Sun*, *Mars*, *Jupiter* and *Saturn* to move round the *Earth*, but *Mercury* and *Venus* in an Epicycle round the *Sun*.

Tycho Brahe ſuppoſed the *Moon*, *Sun*, and *Fix'd Stars* to move round the *Earth*; but *Mercury*, *Venus*, *Mars*, *Jupiter* and *Saturn*, round the *Sun*, and the Orbit of *Mars* to cut that of the *Sun*.

Ricciolus ſuppoſed the *Moon*, *Sun*, *Jupiter*, *Saturn*, and the *Fix'd Stars*, to move round the *Earth*; but *Mercury*, *Venus* and *Mars* round the *Sun*, and the Orbit of *Mars* to cut that of the *Sun*.

The *Pythagorean* or *Copernican* Syſtem, improv'd by *Kepler* and the Modern Aſtronomers, ſuppoſe, That *Mercury*, *Venus*, the *Earth*, *Mars*, *Jupiter* and *Saturn*, make their Revolutions in Elliptic (or nearly ſuch) Orbits round the *Sun* as the Common Focus, and the *Moon* about the *Earth*, deſcribing in every Revolution a different Orbit, alſo the *Satellits* about *Jupiter* and *Saturn*, And the *Comets* likewiſe about the *Sun* in very Oblong Elliptic Orbits.

And the Squares of the Periodic Times of the *Earth* and *Primary Planets* revolving about the *Sun*, as alſo the *Satellits* round *Jupiter*, are as the Cubes of their mean diſtances from the *Sun*, or *Jupiter*.

The five Primary Planets, the *Earth* and *Comets* by Radij drawn to the *Sun*, as alſo the *Satellits* of *Jupiter* by Radij drawn to its Centre, deſcribe Areas porportional to the Times of Deſcription.

Alſo

Alſo moſt of the Planets revolve about their own Axis from Weſt to Eaſt, the *Sun* in about 25 Days, the *Moon* in 29 Days, *Jupiter* in 10 Hours, *Mars* and the *Earth* in about 24 Hours, *Venus* in 23 Hours.

And from hence all the Cœleſtial Appearances are eaſily ſolved.

For ſince the *Earth* revolves from Weſt to Eaſt about its own Axis in about 24 Hours, therefore all the Stars ſeem to be carried from Eaſt to Weſt in the ſame time.

And ſince the *Earth* is carried round the *Sun* from Weſt to Eaſt once in a Year, and that its Centre of Gravity deſcribes the *Orbis Magnus* or Ecliptic; Therefore, the *Sun*, as to Senſe, is carried to the Eaſt.

The *Earth* alſo, in its Annual Motion in the Ecliptic, keeps its Axis always parallel to it ſelf: Whence it follows, that the Axis of the World does n't always point to the ſame place in the Heavens; but the Diameter of the *Orbis Magnus* being inſenſible in reſpect to the diſtance of the fix'd Stars; therefore no fix'd Star in the Meridian is farther diſtant from the Zenith at one Time of the Year than at another.

The common interſection of the Equator and the Ecliptic is found to move from

East to West in about 25900 Years, therefore so great is the alteration of the Parallelism of the *Earth*'s Equatorial Axis; This Motion is called the *Præcession of the Equinox.*

Hence 'tis that the *Fix'd Stars* appear to move in Consequentia, the Equinoctial Points receding from them in Antecedentia.

About one Hemisphere of the *Earth* is constantly Illuminated; and the *Circle of illumination*, or the bounds of Light & Shade, is always perpendicular to a Right Line connecting the Centres of the *Earth* and *Sun*: And consequently the *Sun* seems to be *Vertical* to that Place on the *Earth* thro' which that Perpendicular passes; but *Horizontal* to all those Places which lye under the *Circle of illumination*. It is also said to *Rise*, or *Set*, when the Vertex cuts the Circle of illumination, and to *Culminate* when it cuts the Meridian the *Sun* is in.

And therefore when the *Earth* is in *Aries*, or *Libra*, all the Inhabitants of the Equator have the *Sun* vertical once in a Diurnal Revolution; and since the Axis of the Earth lies then in the Plane of the *Circle of illumination*, therefore that Plane divides the Diurnal Peripheries, describ'd by the Vertices of all Places, into two equal parts; consequently that Day will every

every where be equal to the Night.

But when the *Earth* is in any other Point of its Orbit, the *Circle of illumination* will cut the Diurnal Peripheries into two unequal parts; and therefore the Days and Nights will be unequal.

Thus 'tis eaſie to reconcile every Appearance concerning the difference betwixt Days and Nights, Winter and Summer, with all the Varieties that depend on them.

And with the ſame facility may be conceiv'd why the Planets ſeem to be *Direct*, *Stationary*, or *Retrograde*.

For the Superior Planets are in Conjunction with the *Sun*, while the *Earth* is carried the contrary way; therefore, they appear ſwifter when *Direct*; But about the Oppoſition, the *Earth* is carried the ſame way with them, moving ſlower behind; whence they appear *Retrograde*.

But becauſe the *Orbits* of *Venus* and *Mercury* are within the *Orbis Magnus*, their Retrogradation is greater towards the Perigæon Conjunction: For the Planet then ſeems to be carried ſwifter than the *Earth* in Antecedentia.

Neither the *Sun* or *Moon* can ſeem Retrograde, for the *Sun*'s apparent Place is always Oppoſite to the Place of the *Earth*; And the *Moon* is carried about the Earth in an Epicycle.

Alſo

Alſo the variety of Latitudes in the Planets, not only in different Points of their Orbits, but alſo in the ſame, is eaſily accounted for, by the immutable Inclination of the Orbit to the Ecliptic, and the different Places of the *Earth* in the Ecliptic reſpecting the Planets.

And the manner how *Venus* and *Mercury* come to have the ſame alteration in Phaſes as the *Moon*, is hence alſo evident.

For as at the Oppoſition, the enlighten'd Hemiſphere of the *Moon* is expos'd to us, whence 'tis ſaid to be *Full-Moon*; and about the Conjunction but a ſmall part of the enlighten'd Hemiſphere is expos'd to us, whence the *Moon* appears Horn'd; So *Venus* and *Mercury*, when above the *Sun*, expoſe their enlighten'd Hemiſpheres to us, and therefore appear Full at the Apogæon, and Horn'd at the Perigæon Conjunction; and at the greateſt Elongation, they appear Biſſected.

When the *Superior Planets* are in Conjunction with, or in Oppoſition to the *Sun*, they expoſe their enlighten'd Hemiſpheres to us, and therefore appear Leaſt about the Quadratures, where the Parallax of the Orb is greateſt.

Alſo the mean Diſtance of *Saturn*, *Jupiter* and *Mars* from the *Earth* is found by the Parallax of the Orb to be about Decuple, Quintuple,

tuple, and Seſquialter of the *Sun*'s mean diſtance from the *Earth*. And their Greateſt Diſtance exceeds the Leaſt by the Diameter of the *Orbis Magnus*; But the Greateſt diſtance of *Venus* and *Mercury* from the *Earth* exceeds the Leaſt by the Diameters of their own Orbits.

The Difference of the Apparent Diameter of the ſame Planet, ariſes from hence alſo, and is very remarkable in *Saturn* and *Jupiter*; But *Mars*, about the Oppoſition, appears ſeven times greater than about the Conjunction, *Venus* ſix times, and *Mercury* above twice as big about the Perigæon Conjunction.

When the Apparent Diameter and Diſtance of a Planet are known, its True Diameter, and conſequently its Magnitude may be found.

The Planets Diſtance from the Earth in Semidiameters.

	greateſt	mean	leaſt
Saturn	244330	210000	175670
Jupiter	142919	115000	87081
Mars	58978	23500	8022
Sun	22374	22000	21626
Venus	38415	22000	5585
Mercury	32704	22000	11296
Moon	61	56	52

The *Sun*'s Horizontal Parallax being 10″; and its Apparent Diameter, at mean Distance from the *Earth*, 32′, 15″.

And 'tis evident from the different Phases of *Venus*, *Mercury* and *Mars*, and from the Eclipses of the Satellits of *Jupiter*, and *Saturn*, that the Planets borrow their Light from the *Sun*; But the *Fix'd Stars* shine by their own Light, and are so many *Suns* plac'd at an immense distance from us, and from one another.

And 'tis very Probable that they may have *Planets* revolving about them, and these *Planets* have *Satellits*, and each of these the Habitation of Animals, analogous to those of our *System*.

The

THE Uſe of the GLOBES.

PROBLEM I.

To find the Latitude *and* Longitude *of any given Place on the Earth.*

BRing the Place to the Meridian, by turning the Globe about.

Then, the Degree of the Meridian over it ſhews the *Latitude*.

And the Degree of the Equator at the Meridian ſhews the *Longitude*.

Thus the		*Latitude*		*Longitude*		
Of	*Rome*	is 41 ¾°	N.	12 ¾°	E.	from *Lond.*
	Paris	48 ¾	N.	2 ¼	E.	
	Madrid	40 ¼	N.	3 ¼	W.	
	J. St. Helena	15 ¾	S.	6 ½	W.	

Hence, if the *Latitude* and *Longitude* of of any Place be given, that Place is eaſily found.

PROB-

PROBLEM II.

Given, *the Day of the Month*;
Reqd. *the Sun's Place.*

IN the Kalendar on the Horizon, againſt the Day of the Month are found the Sign and Degree the *Sun* is in. Thus,

April	4th.	*Sun's Place*	25° ♈
July	27th.	———	14½ ♌
November	15th.	———	4 ♐
January	1ſt.	———	22 ♒

Hence, if the Sun's Place is given, the Day of the Month may be found.

PROBLEM III.

1 *To Rectify the Globe for the* Latitude.

SEt the Globe upon an Horizontal Plane, with its Parts anſwering thoſe of the World; Elevate the Pole above the Horizon according to the *Latitude* of the Place.

2 *To Rectify for the Zenith.*

Reckon the Latitude on the Meridian from the Equator towards the Elevated Pole

Pole, and there Screw the Quadrant of Altitude.

3 *To Rectify the Hour-Index.*

Bring the Sun's Place (found by Prob. 2) to the Meridian, then ſet the Index to 12 at noon.

PROBLEM IV.

To find the Diſtance of any two places on the Globe.

Lay the Quadrant of Altitude on both Places; or take the diſtance betwixt them with a Pair of Compaſſes, and apply it to the Equator.

And the Degrees on the Quadrant betwixt them; or thoſe on the Equator between the feet of the Compaſs, multiply'd by 73, is the Diſtance ſought in Miles, each of 5000 of *London* Feet.

PROBLEM V.

To find the Angle of Poſition of Places, or the Angle made by the Meridian of one Place, & a great Circle paſſing thro' both Places.

Rectify for the Latitude of one of the given Places, and bring it to the Meridian

ridian; there fix the Quadrant of Alt. and ſet its graduated Edge to the other Place.

Then will the Edge of the Quadrant cut the Horizon in the degree of *Poſition* ſought.

Thus, the *Angle of Poſition* of the *Lands-end* of *England* from *Barbadoes* is 37½ deg. North Eaſterly, which is the Angle made by the Meridian of *Barbadoes* and a Great Circle paſſing thro' that Place and the *Lands-end*.

But the *Angle of Poſition* of *Barbadoes* from the *Lands-End* is 71½ deg. South-Weſterly.

Hence it is to be noted, that neither of theſe Poſitions can be the true Bearing or Point of the Compaſs leading from the one to the other.

For the *Loxodromic* or *Rumb-Lines* make every where Equal Angles with the Meridian, and are *Aſymptotes* to the Poles of the Equator.

PROBLEM VI.

Given, *the Month and Day*;
Reqd. *thoſe Places of the Globe, over whoſe Heads the Sun is ſuppos'd to paſs that Day.*

BRing the Sun's Place (found by Prob. 2) to the Meridian; Note the Degree over it. Then

Then turning the Globe round, all Places, that paſs under that Degree, will have the Sun vertical that Day.

PROBLEM VII.

Given, *the Month, Day, and Hour*;
Reqd. *at what Place the Sun is Vertical or in the Zenith, at that Hour.*

BRing the Sun's Place (found by Prob. 2) to the Meridian, and note the Degree over it; Set the Index to the given Hour; Turn the Globe till the Index come to 12.

Then the Place of the Earth under the aforeſaid Degree of the Meridian has the Sun in the Zenith at that moment.

PROBLEM VIII.

Given, *the Month, Day and Hour*;
Reqd. *all thoſe Places of the Earth where the Sun is then Riſing, Setting, or Culminating; alſo Day-light, Twilight or Dark-night.*

FInd the Place where the Sun is vertical at the given Hour (by Prob. 7) Rectify for the Latitude of that Place, and bring it to the Meridian.

Then

Then, all thoſe Places, that are in the Weſt Semicircle of the Horizon, have the Sun *Riſing*.

Thoſe in the Eaſt Semicircle have it *Setting*.

Thoſe in the Meridian have it *Culminating*.

Thoſe Places, that are above the Horizon, have the Sun above the Horizon ſo many Degrees as the Places themſelves are.

Thoſe Places that are under the Horizon, but within 18 Degrees, have *Twilight*.

And thoſe Lower than 18 Degrees *Dark-Night*.

PROBLEM IX.

Given, *any Place and hour of the Day*;
Reqd. *thoſe Places on the Earth, where 'tis Noon, Midnight, or any given Hour at that time.*

BRing the given Place to the Meridian; Set the Index to the given Time of the Day; Turn the Globe about, till the Index point at the Hour deſir d:

Then with all thoſe under the Meridian, 'tis Noon, Midnight, or that given Hour at that Time.

PROB-

PROBLEM X.

Given, *the Latitude of the Place, and Hour of the Day.*

Reqd. *to know what a Clock it is in any given Place of the Earth at that Time.*

RECtify for the Latitude of the Place you are in, and bring it to the Meridian; Set the Hour-Index to the given Time; Bring the given Place to the Meridian.

Then the Index will point to the Hour of the Day at that Place.

Thus, when 'tis Noon at *London.*

At	*Surrat*	'tis 5	Hours	P. M.
	Port-Royal	6 ½	——	A. M.
	Bantam	7	——	P. M.

PROBLEM XI.

Given, *the Latitude, and Hour*;

Reqd. *the Situation of any given Point in the Heavens.*

Rectify for the Latitude, Zenith, and Index; Turn the Globe till the Index points to the given Hour.

Then

Then will the Globe ſhew the Poſition of the Sun and Stars.

For thoſe Stars that are then in the *Eaſt*, or *Weſt* Part of the Horizon, are *Riſing*, or *Setting*.

Thoſe in the Meridian are *Culminating*.

And if the Quadrant be laid on any given Point, it ſhews its *Altitude* and *Azimuth*.

Hence in a clear night, the Globe being ſet to the Preſent Time, one may eaſily know the Conſtellations.

PROBLEM XII.

To find the Latitude and Longitude of any given Star.

Put the Centre of the Quadrant of Alt. on the Pole of the Ecliptic; and its graduated edge on the given Star.

Then the Arc betwixt the Star and the Ecliptic is the *Latitude*.

And the Degrees cut on the Ecliptic is the *Longitude*.

Thus

		Latitude	Longitude
Of	*Arcturus*	is 31° N.	20° ♎
	Procyon	16 S.	21¾ ♋
	Sirius	39½ S.	10 ♑
	Spica Virg.	2 S.	19¾ ♍

PROBLEM XIII.

To find the Declination, and Right Aſcenſion of any given Point in the Heavens.

BRing that Point to the Meridian, by turning the Globe about.

Then the Degree of the Meridian over it ſhews the *Declination.*

And the Degree of the Equinoctial at the Meridian ſhews the *Right-Aſcenſion.*

Thus,

	The *Sun*'s	*Declinat.*	*Rt. Aſcen.*
On	April 4th. is	9¾ N.	22 Deg.
	July 27th.	16½ N.	136½
	Novem. 15th.	21 S.	241½
	Jan. 1ſt.	21¾ S.	293¾
Arcturus		20¾ N.	210½
Sirius		16¼ S.	98
Procyon		6 N.	111
Spica Virg.		9½ S.	197½

PROB-

PROBLEM XIV.

Given, *the Latitude of the Place.*

Reqd. *the Amplitude, Oblique Aſcenſion and Deſcenſion, Aſcenſional Difference, the Semidiurnal Arc, the Hour of Riſing and Setting, and the Time of continuance above the Horizon, of any given Point in the Heavens.*

RECtify for the Latitude and Index;

Bring the given Point to the *Eaſt*, or *Weſt* part of the Horizon.

Then the Arc betwixt it, and the *Eaſt* or *Weſt* point of the Horizon ſhews the Amplitude.

The Degree of the Equinoctial in the Horizon ſhews the *Oblique Aſcenſion*, or *Deſcenſion*.

The Time between the Index and 6, or the Difference between the Right and the Oblique Aſcenſion or Deſcenſion is the *Aſcenſional Difference*.

The Aſcenſional Difference *added* to, or *Subtracted* from 6, in *North*, or *South* Declination, gives the *Semidiurnal Arc*; whoſe Complement to a Semicircle is the *Seminocturnal Arc*.

And

And the Index ſhews the time of *Riſing* or *Setting*: Or the Semidiurnal, or Seminocturnal Arc reduced into Time gives the *Setting* or *Riſing*.

Alſo the Diurnal, or Nocturnal Arc, reduced into Time, gives the *Time of Continuance above the Horizon*.

Thus, in 51½ Deg. North Latitude, on *April* the 4th.

The *Sun's*

Amplitude is 15 Deg. N.
Oblique Aſcenſion 10½ Deg.
Oblique Deſcenſion 30 Deg.
Aſcen. Difference 11½d. or ¾ of an Hour.
Semidiurnal Arc 101¼ Deg.
Sun *Riſes* at ¼ after 5
Sun *Sets* at ¾ after 6.

Sirius's

Amplitude 26¾ Deg. S.
Oblique Aſcenſion 119¼ Deg.
Oblique Deſcenſion 76 Deg.
Aſcen. Difference 21¼ Deg.
Semidiurnal Arc 68¾ Deg.
Continuance above Horiz. 9 Hours.
And on the 1ſt of *January*,
Riſes at 6 h. P. M.
Sets at 3 h. A. M.

PROBLEM XV.

Given, *Any Latitude, less than 66½d. and Day of the Month.*

Reqd. *The Length of the Day and Night.*

RECTIFY for the Latitude; Bring the Sun's Place (found by Prob. 2) to the East part of the Horizon; Set the Hour-Index to 12 at Noon; Bring the Sun's Place to the West Part of the Horizon:

Then the Hours from 12 to that, where the Index Points, shew the *Length of the Day.*

And its Complement to 24 is the *Length of the Night.*

Or,

The Hour of the Sun's *Rising*, or *Setting* doubled gives the Length of the *Night*, or *Day*.

Thus, on *April* the 4th at *London.*

The Length of the { *Day* is 13½ Hours. / *Night* is 10½ Hours.

PRO-

PROBLEM XVI.

Given, *The Latitude, and Day of the Month*;
Reqd. *The Beginning, Ending, and Duration of Twi-light and Dark-night.*

FInd the Sun's Place (by Prob. 2.) Rectify for the Latitude, Zenith, and Index; Bring the Sun's Place 18 Degrees below the Horizon, by moving the Globe Weſtward, or Eaſtward, till 18 Degrees of the Quadrant of Alt. cuts the Point of the Ecliptic oppoſite to the Sun's Place:

Then will the Index ſhew when *Twi-light Begins, or Ends.*

The Time, when Twi-light begins, taken from the Time of the Sun's Riſing, leaves the *Duration of Twi-light.*

And double the Time when Twi-light begins gives the *Length of Dark-night.*

Thus at *London*, *January* the 25th.

The *Twi-light* { *Begins* 5½ A. M.
Ends 6½ P. M.
Laſts 2 Hours

'Tis *Dark-night* for 11 Hours.

PROBLEM XVII.

Given, *the Latitude and Day of the Month*;
Reqd. *the Hour of the day, when the Sun ſhines.*

Rectify for the Latitude; Situate the Meridian due North and South; Fix a needle perpendicular to the Sun's Place in the Ecliptic (found by Prob 2.) Bring the needle to the Meridian; Set the Index to 12 at noon: turn the Globe about till the Needle caſt no ſhadow.

Then will the Index point to the *Hour of the Day.*

PROBLEM XVIII.

Given, *two known Stars in one Azimuth, or one Almicantar.*
Reqd. *the Hour of the Night.*

Rectify for the Zenith, and Index.

1. *Where the two Stars have one Azimuth.*

Move the Globe, and alſo the Quadrant 'till the Stars be brought to its edge:

Then will the Index ſhew the *Hour of the Night.*

2 *Where the two Stars have one Almicantar.*

Move the Globe till the ſame Degree on

on the Quadrant cut both Stars:

Then will the Index ſhew the *Hour of the Night.*

PROBLEM XIX.

Given, *the Latitude, Day of the Month, the Sun, or Star's Place and Altitude.*
Reqd. *the Azimuth, and Hour of the Day, or Night.*

Rectify for the Latitude, Zenith, and Index; Bring the Sun or Star's Place to the given degree of Altitude:

Then the Quadrant ſhews the *Azimuth* in the Horizon.

And the Index ſhews the *Hour.*

Thus, in Latitude 51½d. North, on *May* the 9th.

When *Sun*'s Alt. is 12 degrees.

'Tis then 5½h. A. M. or 6½h. P. M.

On *May* the 16th at Night, when *Arcturus*'s Alt. is 50 degrees, 'tis then 11 of the Clock.

And on *October* the 2d at night, when *Aldebaran*'s Alt. is 30 degrees, 'tis then 9 of the Clock.

PROBLEM XX

To find the Latitude of that Point on the Earth, where the Longeſt Day is of any given Number of Hours, under 24.

BRing the Solſticial Point to the Meridian; Set the Index to 12; Turn the Globe Weſtward till the Index point to half the numbers of Hours given; Keep the Globe in that Poſition with the Meridian; Slide the Meridian in the Notch till the Solſticial Point comes to the Horizon: That elevation of the Pole is the Anſwer.
Thus, if 17 hours were given; the Lat. is $54\frac{1}{2}$ degrees.
If 22 hours were given; the Lat. is $65\frac{3}{4}$ degrees.

PROBLEM XXI.

To find the Latitude of that Point on the Earth, where the Longeſt Day is of any given number of Natural Days, under 182.

In the Ecliptic, find a Point half ſo many degrees diſtant from the Solſticial Point as there are days given; Bring that Point to the North Part of the Meridian; Keep the

the Globe in that Poſition; Slide the Meridian till the ſaid Point comes to the North Point of the Horizon: That elevation of the Pole is the Anſwer.

Thus, if 30 days were given; The Lat. is 67 degrees.

If 60 days were given; the Lat. is 69¾ degrees.

PROBLEM XXII.

Given, *the Latitude of any Place*;
Reqd. *the Length of the Longeſt and Shorteſt Days and Nights in that Place.*

Rectify for the Latitude; Bring the Solſticial Point of that Hemiſphere to the Eaſt part of the Horizon; Set the Index to 12 at noon; Turn the Globe about till the Solſticial Point touches the Weſt part of the Horizon.

Then the Hours from 12, reckon'd by the Index, ſhew *the Longeſt Day*: Whoſe Complement to 24 ſhews the *Shorteſt Night*.

And their reverſe gives the *Shorteſt Day*, and *Longeſt Night*.

	Longeſt Day	*Short. Night.*
Thus in Lat.	51°½ N. 16½ h.	7½ h.
Lat.	63 ½ 20 h.	4 h.
Lat.	17 13 h.	11 h.

PRO-

PROBLEM XXIII.

Given, *the Day of the Month*;
Reqd. *the Hour when any given Star comes to the Meridian.*

BRing the Sun's Place (found by Prob. 2) to the Meridian; Set the Hour Index to 12; Turn the Globe till the given Star is under the Meridian:

Then will the Index Point at the Time ſought.

Thus, on the 21ſt of January, *Sirius* will be upon the Meridian at ½ an hour after 9.

On the 1ſt of January *Aldebaran* will be upon the Meridian at ¾ of an hour after 8.

And on the 28th of *October*, *Arcturus* will be upon the Meridian ¼ after 11 of the Clock.

PROBLEM XXIV.

Given, *the Latitude, Day, and Hour, with the Sun or Star's Place*;
Reqd. *the Sun or Stars Altitude, and Azimuth.*

REctify for the Latitude, Zenith, and Index; Turn the Globe about till the Index

Index points to the given Hour; Set the Quadrant of Alt. to the Sun or Star's Place: There it ſhews the Altitude. And the Quadrant ſhews the Azimuth in the Horizon.

Thus, at *London*, the Sun's	Alt.	*Azimuth.*
On *Novem.* 3d	at 8 A. M. 3°½	S. 58° E.
On *Auguſt.* 19th	at 6 P. M. 8°	N. 85° W.
On *April.* 17th	at 7 A. M. 20°	S. 87° E.

PROBLEM XXV.

Given, *the Time that a Star comes to the Meridian*;
Reqd. *the Sun's Place.*

BRing the Star to the Meridian; Set the Index to the given time; Turn the Globe about till the Index point to 12 at Noon: Then will the Meridian cut the Ecliptic in the *Sun*'s Place.

PROBLEM XXVI.

Given, *the Latitude, Day of the Month, the Sun or Star's Place and Azimuth*;
Reqd. *the Altitude, and Hour of the Day, or Night.*

REctify for the Latitude, Zenith and Index; Keep the Quadrant to the Azimuth

on the Horizon; Bring the Sun, or Star's Place to the Quadrant:

Then the Degree of the Quadrant over it ſhews the *Altitude.*

And the Index ſhews the *Hour.*

PROBLEM XXVII.

Given, *the Latitude of the Place;*
Reqd. *the Hour of the Day by the Globe, when the Sun ſhines.*

SEt the Globe upon an Horizontal Plane, with the Meridian due North and South:

1. In the *Summer* half-year, raiſe the Pole above the North Part of the Horizon according to the given Laritude.

2. In the *Winter* half-year, depreſs that Pole as much below the South part of the Horizon.

Then will the ſhade of the Axis upon the Hour-Circle ſhew the *Hour of the day.*

PROBLEM XXVIII.

How, by the Globe, to find the Sun's Altitude, when it ſhines.

THe Globe being ſet upon an Horizontal Plane, turn the North Pole of the

the Globe to the Sun; Move it up and down till the Axis caſt no Shadow:

Then the Arc of the Meridian intercepted betwixt the Pole and Horizon is the Altitude of the Sun above the Horizon.

PROBLEM XXIX.

To find when a given Star will be upon the Meridian, at a given Hour of the Night.

BRing the Star to the Meridian; Turn the Globe Eaſt-ward till the Index point at an Hour as far diſtant in the forenoon from 12 as the given Hour is in the afternoon; Note the degree of the Ecliptic at the Meridian: Then againſt this degree in the Kalendar on the Horizon, is found the Day of the Month that the given Star will be upon the Meridian at the given Hour.

PROBLEM XXX.

Given, *the Latitude of the Place*;
Reqd. *the Coſmical Riſing and Setting of a given Star.*

REctify for the Latitude; Bring the given *Star* to the Eaſt, or Weſt part of the Horizon; Note the Degree of the Ecliptic

cliptic then Riſing, or Setting:

Then right againſt this degree, in the Kalendar on the Horizon, is found the Day of the Star's *Coſmical Riſing, or Setting.*

Thus, in the Latitude of 51½*d* N. *Sirius* riſes Coſmically on the 31ſt of July; and ſets Coſmically on the 5 of *November.*

PROBLEM XXXI.

Given, *the Latitude of the Place.*

Reqd. *the Acronical Riſing, or Setting of a given Star.*

REctify for the Latitude; Bring the Star to the Eaſt, or Weſt part of the Horizon: Note the degree of the Ecliptic then Riſing:

Then right againſt this degree, in the Kalendar on the Horizon, is found the Day of the Stars *Acronical Riſing*, or *Setting.*

Thus, in the Latitude of 51½*d.* North, *Sirius* riſes *Acronically* on the 26th of January; and ſets *Acronically* on the 3*d.* of *May.*

PRO-

PROBLEM XXXII.

Given, *the Latitude of the Place*;
Reqd. *the Heliacal Riſing, or Setting of a given Star.*

REctify for the Latitude, and Zenith; Bring the given Star to the Eaſt, or Weſt Part of the Horizon; On the Weſt, or Eaſt ſide, bring that degree of the Quadrant which is the Star's Arc of viſion to touch the Ecliptic.

Then, in the Kalendar, right againſt the degree of the Ecliptic oppoſite to the Point touched, is found the Day when the given Star *Riſes*, or *Sets Heliacally.*

Thus, in Latitude 51½*d.* North, *Sirius* riſes *Heliacally* on the 15th of *Auguſt*, and ſets *Heliacally* on the 16th of *April*

PROBLEM XXXIII.

To find the Antœciens, Periœciens, *and* Antipodes *of any given place.*

1. Bring the given Place to the *Meridian*; count the diſtance from the Equator in Degrees.

Then ſo many degrees reckon'd on the Meridian, from the Equator towards the

contrary Pole, ſhews the Place of the *Antœciens*.

2. Keep the given place under the Meridian; Set the Index to 12 at Noon; Turn the Globe about till the Index Points at Mid-night: Then the Place at the ſame degree of the Meridian is that of the *Periœciens*.

3. And the *Antipodes* of the given Place is where it's *Antœciens* ſtood before.

PROBLEM XXXIV.

Given, *the Day and Hour of a Solar, or Lunar Eclipſe*;
Req'd, *thoſe Places on the Earth in which the ſame will be viſible.*

FInd the Sun's Place (by Prob. 2) and its oppoſite point or the Moon's Place; Seek that Place of the Earth (by Prob. 7) where the Sun is vertical at the given Hour, for a *Solar*, but its Antipodes (by Prob. 33) for a *Lunar Eclipſe*, and bring it to the Pole of the Horizon:

Then will the Eclipſe be viſible to all Places in the upper Hemiſphere, except thoſe near the Horizon.

PRO-

PROBLEM XXXV.

Given, *the Sun's Declination, and Meridian Altitude*:
Reqd. *the Latitude of the Place.*

NOte the point of Declination on the *Me*ridian, from the Equator, according as it is either North or South; Slide the *Me*ridian up or down in the Notches of the Horizon, till the point of Declination is ſo far diſtant from the Horizon as is the given *Me*ridian Altitude.

Then is the Pole Elevated to the Latitude ſought.

Thus where the *Sun's Meridian Altitude* is 60 degr. S. and *Declination* 22½ degr. N. the *Latitude* will be 52½ deg. North.

PROBLEM XXXVI.

Given, *by Obſervation, two Stars, one Riſing or Setting, the other at the Meridian*;
Reqd. *the Latitude of the Place.*

BRing the Star obſerv'd at the Meridian to the Meridian, and keep the Globe there; Slide the Meridian up or down in the Notches, till the other Star is brought to the Eaſt, or Weſt part of the Horizon.

Then is the Pole Elevated to the *Latitude* ſought.

PROBLEM XXXVII.

Given, *the Meridian Altitude of any Fix'd Star*;

Reqd. *the Latitude of the Place.*

BRing the Star to the Meridian; Reckon the given Altitude from it downwards, and note that Point; which, if on the South, or North part of the Meridian, bring to the South, or North part of the Horizon:

Then is the Pole elevated to the Latitude sought.

PROBLEM XXXVIII.

Given, *by Observation, the Altitude of two Stars on the same Azimuth*;

Reqd. *the Latitude of the Place.*

SEt the Quadrant over both Stars at the observ'd Degree of Altitude; Slide the Meridian up or down in the Notches, till the Quadrant cuts the given Azimuth in the Horizon.

Then is the Pole elevated to the Latitude sought.

PROBLEM XXXIX.

Given, *the Latitude of the Place, the Sun's Declination and Altitude*;

Reqd.

Reqd. *the Sun's Azimuth, and Hour of the Day.*

REctify for the Latitude and Zenith; Bring the Equinoctial Colure to the Meridian: Set the Index to 12 at Noon; Move the Globe and Quadrant, till the given Declination, on the Equinoctial Colure, meets the given Altitude, on the Quadrant.

Then the Quadrant ſhews the *Azimuth*, on the Horizon.

And the Index ſhews the *Hour of the Day.* Or, the Arc of the Equator intercepted between the Meridian and Colure reduc'd into Time ſhews the *Hour from Noon.*

PROBLEM XL.

Given, *the Latitude, the Sun's Altitude and Azimuth;*

Reqd. *the Sun's Place, and Hour of the Day*

1. REctify for the Latitude, and Zenith; Set the edge of the Quadrant of Alt. to the given Azimuth on the Horizon; Turn the Globe till the Ecliptic cut the Quadrant in the given Altitude.

Then will the Quadrant cut the Ecliptic in the *Sun's Place.*

2.

2. REctify the Hour-Index; Bring the Sun's Place to the edge of the Quadrant of Altitude (remaining at the given Azimuth:) Then will the Index ſhew the *Hour of the Day.*

PROBLEM XLI.

Given, *any two Places on the Globe;*
Reqd. *the Rumb or Courſe of bearing from one to the other.*

1. IF a Rumb-Line paſſes thro' both Places; that Line ſhews the Courſe. Thus, the Courſe from *Cape St. Vincent*, in *Portugal*, to *Cat Iſland*, one of the *Bahama's*, is E. by S.

2. If no Rumb-Line paſs thro' them; that Rumb to which the Places lye moſt parallel ſhews the Courſe:
Thus, the Courſe from the *Lizard* to *Barbadoes*, is N. E. $\frac{1}{2}$ E.

PROBLEM XLII.

Given, *the Latitude, Sun's Place and Altitude;*
Reqd. *To draw a Meridian-Line upon an Horizontal Plane.*

DEſcribe the Circumference of a Circle upon the Plane, with the Chord of 60 deg. Draw a right Line in the Shadow of a Stile erected perpendicularly in the Centre; Rectify for the Latitude and Zenith; Move the Quadrant and Globe about, till the Sun's Al-

Altitude on the Quadrant, and its Place in the Ecliptic meet; Then the degrees on the Horizon intercepted between the Quadrant and Meridian, ſet off in the Circumference of the aforeſaid Circle from the interſection of the Shade Line towards the Sun, finds a Point from which a right Line drawn thro' the Centre, will be the *Meridian Line* ſought.

THeſe are the Chief and moſt common Problems, which generally ſerve to exhibit ſome of the Uſes of the Globes; Tho' there are great variety of other uſeful caſes in Aſtronomy, and Geography; as alſo in Navigation and Dialing, which may be perform'd with the like facility, for in every oblique angl'd Spheric Triangle 60 different Problems may be propos'd, and in every Right angl'd one 30.

But as moſt of theſe in Practice require extreme exactneſs, which the Globe cannot well admit of, tho' the nobleſt Inſtrument of any, to inform the Fancy, and to give a clear and diſtinct Idea of the thing Propos'd to be done; therefore 'twas not thought neceſſary to be particular in all that might have bin given: Since, we hope, if what is already ſaid be well underſtood, there can no manner of difficulty ariſe in applying it to other caſes when requir'd.

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